Preserving Forages as Haylage of Silage

Michigan State University
Cooperative Extension Service
Don Hillman and J.W. Thomas, Department of Dairy Science

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By Don Hillman and J. W. Thomas,
Department of Dairy Science

COOPERATIVE EXTENSION SERVICE
MICHIGAN STATE UNIVERSITY

Fresh, nutritious, green-chopped forage must be properly ensiled to preserve high quality.

Alfalfa preserved as wilted silage (65-72% moisture) retains dark green color, high quality protein.

Haylage at 50% moisture, or more, can be excellent feed when properly ensiled.

Haylage containing only 40% moisture shows browning and has a caramelized odor. Part of the protein is unavailable for digestion. It is also lower in energy and Vitamins A. D. & E.

Poorly preserved haylage seriously damaged by over heating in the silo. Forages that are too mature, too dry, chopped too long, and exposed to air are subject to such deterioration.

Processing the hay crop as haylage or wilted silage can help to improve forage quality by (1) allowing harvesting at the proper stage of growth of the plant and (2) reducing the risk of weather damage and loss of leaves since less field drying time is required. Also, forage harvesting can proceed faster since less drying time is required and the crop can be stored over a wide range of moisture content.

Several studies have shown that properly preserved forage harvested as haylage or wilted silage normally contains about 2% more protein, and higher energy value than when harvested as field-cured hay. Presumably this is because of the lower loss of leaves and fine stems.

Avoid Heat Damage in Storage

Failure to employ proper ensiling practices that exclude air results in excessive heating of haylage or silage. Recent studies show that haylage that has been heat-damaged in storage is lower in protein digestibility and energy value. Storage losses from excessive heating may be substantial.

Milk production of dairy cows and livestock growth can be seriously reduced when fed heat-damaged forages depending on the degree of heating that has occurred.

The degree of caramelization and browning of the forage as removed from storage is evidence of heat damage. Forage having a high degree of caramelization or browning has gone through more than normal heating in the silo. Forage that is black when removed has been extensively damaged by heating. Air was not sufficiently excluded from the forage during storage.

A procedure for determining the availability of protein known as the ADF-nitrogen test (acid detergent fiber nitrogen) can be performed by some laboratories to estimate the digestibility of protein in forages. The common crude protein analysis (Kjeldahl) measures only the total nitrogen present and tends to overvalue the protein in feeds that have been damaged by heating.

Preserving Haylage and Silage

Heat damage is caused by chemical oxidation (burning) of the sugars in the forage. If excessive air is trapped in the forage, or outside air is permitted to enter through loosely packed material, oxidation may proceed rapidly. When the oxygen supply is exhausted, the heating will stop. But if air continues to enter the forage mass, oxidation may continue until spontaneous combustion occurs.

Exclusion of air by packing and by providing a tight container is the best way to prevent heat damage. The following procedures are recommended to exclude air from the silage mass.

1. Provide a tight silo. The walls and doors of new silos are usually air tight. However, older silos may have air leaks in the walls or around the doors. These should be reconditioned by a reputable silo repair company and/or calked and sealed. The drain hole should be plugged if haylage is to be stored in the silo. While semi-sealed silos are helpful for excluding air, they are not air tight since they must be opened for feeding and air can penetrate loosely-packed forage.

2. Maintain proper moisture content. Alfalfa will retain 70% moisture (30% dry matter) without seepage at normal silo pressures. To allow a safe operating range, start filling when the forage has wilted to about 70% moisture. Later loads usually will be dryer but most of the forage will contain 50% moisture or more. Haylage usually contains 40 to 60% moisture. However, if you wait until 50% moisture before filling, much of the forage will be too dry to insure good packing and the risk of heat damage is much greater.

Sufficient moisture is necessary to provide the weight required for good packing. Forage stored in the upper ⅓ of the silo should contain 65 to 72% moisture. This wetter material will help to form a top seal to prevent air from entering from the surface and will provide the weight necessary for expressing the entrapped air from the forage stored below it. Air will move six times easier through haylage containing 50% moisture than through slightly wilted forage. See MSU Extension Bulletin E-441, "An Easy Moisture Test for Forages and Grains" or use a commercially made moisture tester.

3. Harvest at the proper stage of maturity. Legumes such as alfalfa and clover should be harvested in the early bloom stage; grasses in the early stages of heading. Such forages are more tender and pack better in the silo than more mature, fibrous material. In addition, forages harvested in the early stages of growth are higher in protein and energy value and more palatable, resulting in better milk production and growth.

4. Chop reasonably short. Fine chopping helps to exclude air because packing is tighter. A ¼" theoretical cut is desirable with wilted silage at 65% moisture, and becomes absolutely necessary in haylage containing 60% moisture or less. Settling is much faster and the final density (weight per unit of volume) with ¼" cut is 10% higher than ¾" cut and 15% higher than with 1½" cut material at a depth of about 22 feet. Since moisture content increases packing, a ⅜" to ½"

Careful management of ensiling practices can reduce heat damage to haylage and improve its quality.

length cut is satisfactory for forage containing 65% or more moisture. Thus fineness of chopping cannot be overlooked when making haylage in either conventional or sealed silos. Air will penetrate the mass of haylage in sealed silos when the filling port is left open or when the unloading door is opened for feeding. Chopper knives must be kept sharp and set close to the ledger plate. Also, badly worn ledger plates result in poor cutting and higher power requirements.

Extremely fine chopping, such as 1/16", is not necessary and is undesirable if silage is to be the only source of roughage for cattle.

5. DISTRIBUTE EVENLY IN THE SILO. Even distribution in the silo is necessary to avoid separation of the light from heavier material by the silage blower. The light material tends to land next to the wall. Since it is light and fluffy it does not pack well and forms an easy access for air penetration. If the wall happens to leak air, or when the feeding door is opened with bottom unloading silos, a chimney effect is produced. Also, the "pumping" action of changing temperatures and gas pressures at various locations in the silo causes air to move into and out of poorly packed forage.

6. FILL THE SILO RAPIDLY — CONTINUOUSLY IF POSSIBLE. Compaction of the forage depends on considerable height of the material to provide the weight necessary to express air from the mass. Therefore, the upper portion will tend to be less dense and hold more air which causes heating. If the process of filling is delayed over several days, the upper layer from each filling will be noticeably different in quality. One study reports dry matter losses were six percentage points higher when a silo was filled over 8 days rather than in 1 day.

7. APPLY A TOP SEAL OF FORAGE containing 65 to 72% moisture in the top 10 feet to ⅓ of the silo. Level the forage and tramp it in place firmly to express trapped air.

8. FINALLY, CROWN THE CENTER slightly and cover with a plastic silo cap if you intend to delay feeding for several weeks. Dig a small trough in the silage around the silo wall. Place the plastic down into the trough and up against the silo wall. Hold the cap in place with green forage or other weights placed around the edge of the cap.

Bunker Silos — Wilted silage containing 65 to 72% moisture is best for bunker silos. Low moisture silage packs poorly in bunker silos causing excessive heating and losses.

Continuous packing with a wheel type tractor while leveling and filling and periodic packing for 2 to 3 days after filling is desirable to form a good seal at the surface of the silage. Use a plastic silo cover weighted with old tires or other heavy material. The cover will reduce surface spoilage and keep heavy rains and snow from leaching through the silage.

Extent of Heat Damage

ADF-nitrogen analysis of 34 haylage samples from Michigan farms in 1971-72 revealed that one-third of the samples were seriously heat damaged so that only 20 to 80% of the protein was available (average 63%). Another 53% of the samples showed considerable heat damage, with 80 to 85% of the protein available (average 85%). Fifteen percent of the samples showed little heat damage with more than 90% of the protein available for digestion (average 93%).

Type of silo was not related to the average percent of available protein in the above samples. The average percent total crude protein and percent of the protein available for the different types of silos included are shown below.

Type of Silo	No.	Total Crude Protein	Percent of Protein Available	
		%	%	range
Glass-lined	9	14.6	80.9	(58-92)
Cement stave	13	14.7	79.7	(19-96)
Sealed concrete	4	16.7	81.2	(74-89)
Bunker	3	13.4	80.4	(78-82)
Unknown	5	16.8	69.0	(40-84)

Differences in average total crude protein % are meaningless because of small number of samples.

Silage Additives

Unfortunately, there has been very little controlled research information on the value of commercially available silage additives or so-called "preservatives" for improving the fermentation and quality of silage under ideal conditions. This is particularly true with low moisture silage that is poorly packed and exposed to excess oxygen.

Silage additives that contain anti-oxidants or mold inhibitors could be helpful in reducing heat damage to a limited extent providing the silage contains enough moisture. The moisture will insure good packing so that most of the air is squeezed out of the silage mass. Other additives composed mostly of dried molasses, salt or flavor compounds probably are of little, if any, benefit.

The responsibility for proof of the value of any silage additive lies with the manufacturer of the product. Farmers should insist on seeing reliable controlled research data confirming that the product: (1) reduces losses from fermentation, or oxidation, or (2) improves the quality of feed in terms of livestock production compared to untreated silage under the same conditions. Testimony from other farmers is of little value since controlled comparisons are seldom conducted under practical farm conditions. Preservatives should not be expected to replace sound management practices in producing good quality silage.

Recent trials indicate that the addition of propionic acid at the rate of 0.4 to 0.6% (8 to 12 lb. per ton) did reduce the extent of moldy haylage in small silos when ensiled at 40% moisture (60% dry matter). Lower levels have not sufficiently prevented mold development.

Direct cut silage — Bud stage alfalfa and grasses normally contain 80 to 85% moisture as harvested. Ensiling this wet material in upright silos results in excessive degradation of protein, undesirable odor in silage, seepage and deterioration of concrete stave silos. Direct cut silage fed as the major forage generally results in lower consumption of dry matter and lower production of livestock than comparable, well-preserved wilted silage (70% moisture), haylage (50% moisture) or hay.

Forages tend to be drier when cut at late stages of maturity. Therefore, mature forages require very little wilting to achieve 70% moisture, and in some cases, could be better preserved as direct cut silage depending on soil moisture and weather conditions.

Addition of Dry Material

Beet pulp, soybran flakes or other highly absorbent materials can be added to wet forages to absorb some of their moisture and reduce seepage. Beet pulp retains about 2.9 lb. of water per pound compared to alfalfa at 2.3 to 2.5 lb. per pound of dry matter at normal silage pressures. Ground grains such as shelled corn, oats and wheat retain only 0.7 to 0.8 lb. and dry corn cobs finely ground about 2.0 lb. water per pound of dry matter. Grains or ground ear corn are poor choices for absorbing water in silage although most of the added grain will be recovered for feeding.

A ton of 80% moisture silage contains 1600 lb. water and 400 lb. dry matter. The 400 lb. of dry matter will retain about 1000 lb. of water (400 x 2.5) leaving 600 lb. of water to be absorbed.

If beet pulp will absorb 2.9 lb. water per pound, then about 200 lb. of beet pulp will be required per ton of fresh forage to prevent seepage. The resulting mixture will then contain about 71% moisture (29% dry matter). The silage will then be about ⅔ forage and ⅓ beet pulp. If grains are used to decrease the water content of such silage, so much grain has to be added that the silo effectively becomes a grain storage facility rather than a forage storage facility.

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